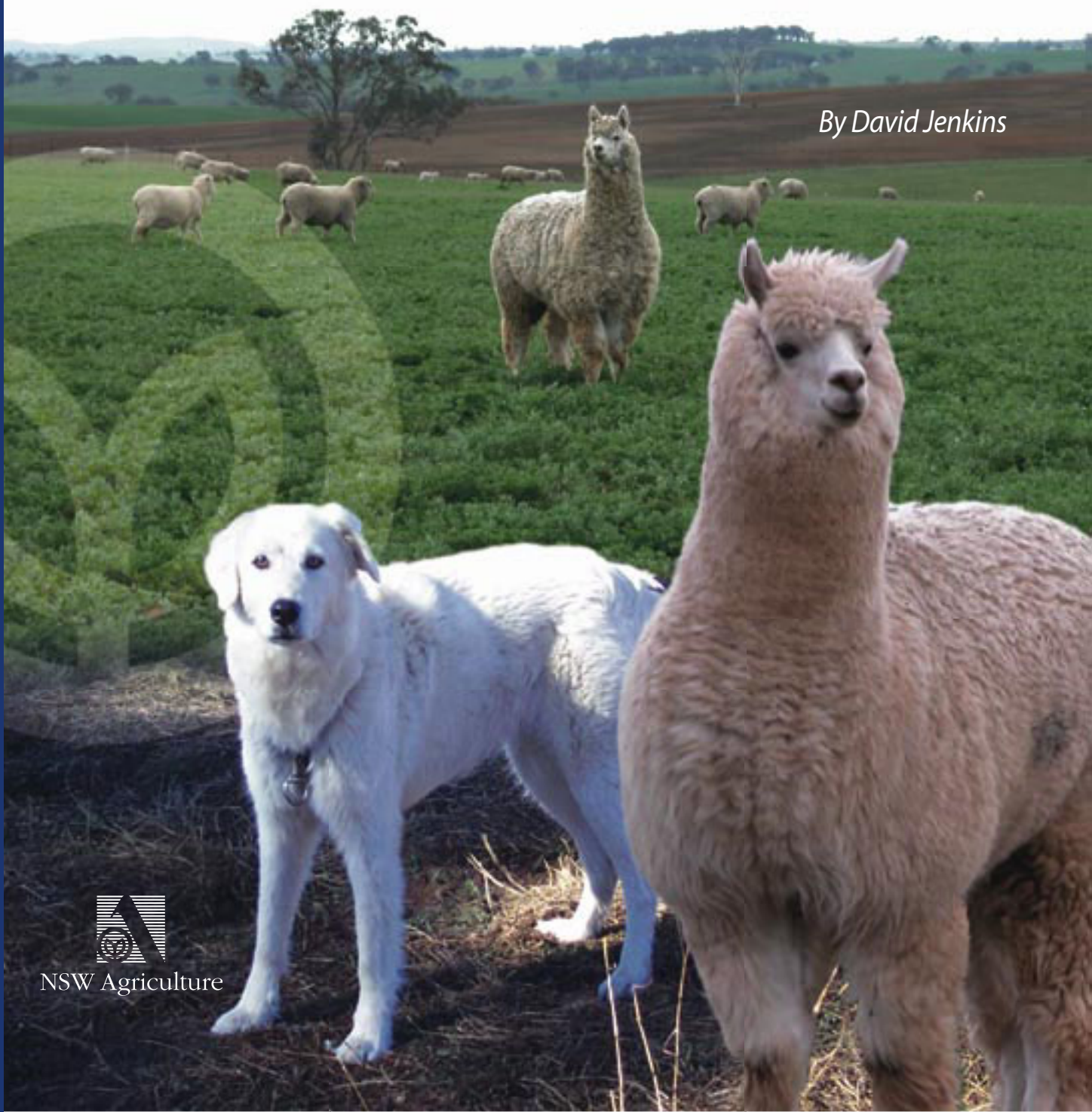


GUARD ANIMALS FOR LIVESTOCK PROTECTION

Existing and Potential Use in Australia

By David Jenkins



NSW Agriculture

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2003

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Photo: D Jenkins



Photo: D Jenkins

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The information contained in this publication is based on knowledge and understanding at the time of writing (September 2003). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up-to-date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user's independent adviser.

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1. Executive Summary and Recommendations

Wild dogs, foxes and domestic dogs, cause major losses to the Australian livestock industry each year. These losses fall into several categories; livestock killed or maimed, production losses, predator control costs and social impacts. Accurate figures of livestock and production losses are unavailable. Annual costs of controlling wild dogs amount to about \$7,000,000 while costs for controlling foxes are unknown, but substantial. The social costs associated with wild dog predation on livestock are important, but the most difficult to determine because they cannot be quantitatively determined.

Many of the breeds of guard dogs were developed in Europe over several thousand years for protecting livestock against wolves and bears. Seven breeds are now available outside their countries of origin (Akbash, Anatolian, Great Pyrenees, Komondor, Kuvasz, Maremma and Sharplaninatz) and together with alpacas, llamas and donkeys have been evaluated in countries outside Australia, mainly in the USA, as guards for livestock.

In US studies, livestock guarding dogs have substantially reduced predation on sheep and goats by a range of predators, mainly coyotes, but also foxes, bobcats, mountain lions and bears. Essential to the success of these dogs is a major input of time in careful training by producers and also close interest in the dog's well being after training, when the dogs are installed in a paddock with the sheep. A number of other issues must also be considered to ensure success of livestock guarding dogs, including paddock and flock size, predator pressure and paddock topography.

US studies have also shown that alpacas, llamas and donkeys reduce predation. The major difference between dogs and the other species used as livestock guarding animals is that training time for alpacas, llamas and donkeys is much shorter than for dogs (a few weeks compared to several months) and alpacas, llamas and donkeys require minimal supervision and can be managed similarly to sheep and goats. Alpacas, llamas or donkeys have management advantages over dogs but in circumstances where the predators are larger and form packs, groups of dogs are the best option. In the majority of US cases, the use of dogs is an adjunct to conventional lethal and non-lethal methods used to counter predation by wild carnivores.

Three breeds of livestock guarding dogs are available in Australia; Anatolians, Great Pyrenees and Maremmas. Of the other guarding species available, alpacas are used most commonly in Australia followed by llamas and donkeys. A telephone survey of 85 producers in the Australian Capital Territory (ACT) and Yass Rural Lands Protection Board (RLPB) area of NSW revealed 8% of those surveyed in the ACT and 3% in the Yass area are using livestock guarding animals. A high level of interest was evident and about half those interviewed would consider using them. Some producers were concerned about fibre contaminating the wool clip when alpacas or llamas were run with sheep. All those interested wanted more information on the effectiveness and cost benefits of livestock guarding animals with many producers prepared to participate in scientifically controlled evaluations.

The conclusions from this review and from the data collected in the telephone survey are that for livestock guarding animals (LGAs):

- 1) A controlled field evaluation of all species and breeds available in Australia needs to be undertaken urgently to determine effectiveness under Australian conditions.
- 2) Cost-benefit analysis and an analysis of the non-financial benefits under Australian conditions should be undertaken and reported.
- 3) An informative extension publication be prepared on training and maintenance of LGAs.

- 4) A comprehensive register of breeders of all species of LGAs and a list of competent trainers of LGDs are needed (a breeders directory has been produced by the Alpaca Association).
- 5) An accurate assessment of the financial and social impacts on producers and the livestock industry, arising from wild dog and fox predation, needs to be undertaken.

2. Introduction

Wild dogs (dingoes and dingo/domestic dog hybrids) and foxes are major agricultural pests in Australia causing severe financial losses in the livestock industry (Fleming *et al* 2001; Saunders *et al* 1995). Dingoes and foxes were introduced into Australia by humans, dingoes by Asian seafarers 4000–5000 years ago (Breckwoldt 1988; Corbett 1995) and foxes by early colonists about 200 years ago (Saunders 1995). Within 30 years of their introduction, foxes had become a proclaimed pest in parts of Victoria and within 100 years they had colonised the continent, except in the tropical north. Today in many areas of Australia wild dingoes share the environment with dingo/domestic dog hybrids (Corbett 1995; Wilton *et al* unpublished data) and in some areas of south eastern Australia, the wild dog population consists almost exclusively of dingo/domestic dog hybrids.

The annual estimated cost of controlling wild dogs in Australia is \$7 million, second only to the cost of controlling rabbits (Fleming *et al* 2001). No data is available on the actual cost of fox control in Australia but it is substantial (Saunders *et al* 1995). The currently employed methods and strategies for controlling these pests (exclusion fencing, trapping and poisoning) are at best, not completely effective, therefore new strategies, such as the use of other species of animal to guard livestock against predators, need to be evaluated. The species of livestock guarding animals (LGAs) used in other countries that need evaluating include various breeds of dog, alpacas, llamas and donkeys.

American producers began using livestock guarding dogs (LGDs) in the 1970s. Since then they have become progressively more popular as a means of predator control. In Colorado the use of LGDs by producers increased from 7% to 68% in seven years (Andelt & Hopper 2000). Dogs are the most popular species used for livestock protection in the USA but alpacas, llamas and donkeys are also used by some producers (Green 1989; Walton & Field 1989; Franklin 1993; Bergman *et al* 1998; Meadows and Knowlton 2000). By 1998, 20% of all US sheep producers were using LGAs either as their sole means of controlling predators (mainly coyotes) or as an adjunct to conventional lethal and/or non-lethal predator control activities undertaken on their farms (Connolly & Wagner 1998).

3. The Need for Livestock Guardian Animals in Australia

Predation of livestock by wild and domestic canids is a major problem for producers in NSW and in all other states and territories in Australia. The total annual losses are unavailable because they are difficult to determine but would easily total several million dollars. As stated above, \$7,000,000 is spent on wild dog control and the sum spent on fox control is not known. The predators involved are wild dogs, foxes and domestic dogs. Most of the wild dog activity occurs on

farms adjoining Crown Land (parks and forests and vacant Crown Land). In NSW, wild dogs are most active in RLPBs in the north eastern and south eastern tablelands whilst foxes are active, mostly against lambs, over most of NSW. Predation of stock by domestic dogs most commonly occurs in situations where producer farms are close to urban centres or hobby farms with non-resident owners.

Exact figures for total annual losses in NSW and nationally are unavailable but several important components of loss arise from the impacts of wild dog, domestic dog and fox predation on livestock. These are:

- Direct costs of lost production because of killing and injuring domestic animals, and causing trauma and mismothering
- Costs for controlling wild fox and domestic predators
- Lost financial/operational opportunities and social costs (this component is the hardest to quantify).

The Cooma RLPB between 1986 and 1996 is presented as an example of annual financial losses due to predation. During this time 981.4 (SD 451.0) sheep were reported as killed annually by wild dogs. At a conservative value of \$55 per head for wool and replacement costs, this equated to \$53,977 annually in predated sheep. An additional 186.3 (SD 87.5) sheep were injured in wild dog attacks. A study by Fleming and Korn (1989) indicated that livestock losses and injuries due to wild dog attacks were under-reported to RLPBs by as much as two thirds, so the figures presented are conservative. In 1997, six new properties in the Cooma RLPB were affected by predation and a number changed enterprise to cattle as a result of losses. This option is not always available to affected producers.

A total of \$35,143 (partly from the Cooma RLPB, NSW National Parks & Wildlife Services, NSW State Government) was spent on wild dog control in the Cooma RLPB area between 1 January and 31 December 1996. In addition, during the same period, producers in the Cooma RLPB had control costs and stock losses conservatively estimated at \$101,931.

This description of the production and livestock losses in the Cooma RLPB does not include the impact and control of foxes and the social and lost opportunity impacts.

4. Livestock Guarding Dogs

The origins of livestock guarding dogs (LGDs) go back almost 6000 years to the region that now includes Turkey, Iraq and Syria (de la Cruz 1995). The first ancestors of livestock guard dogs are thought to have reached Europe from the Caucasus in about 600BC. More recently, livestock guarding dogs were taken to the New World with Spanish colonists. Whilst in Argentina during the voyage of the Beagle, 1832 to 1836, Charles Darwin noted their use by local Indian farmers (Keynes 2002.)

Taylor (1998a: 2000) reviewed the suggestion that livestock are more relaxed if the dogs have the same colouring as the livestock they are guarding. The earliest dogs used to protect sheep and goats were probably similarly coloured to sheep and goats, being black, grey or brown, as can be still seen in the Sharplaninatz today (Section 4.1.7) (de la Cruz 1995). However, the Romans preferred white wool and Roman authors wrote that white guard dogs were selected because they could easily be distinguished from wolves and other predators. This selection criteria combined with the tendency of sheep being more comfortable with white guard dogs may have largely influenced

the development of predominantly white breeds such as the Akbash, Kuvasz, Maremma and the Great Pyrenees seen today (de la Cruz 1995).

Many breeds of LGDs have been developed in different countries (Table 1). The use of some of these breeds for guarding livestock, particularly sheep and goats, has been adopted in other countries e.g. USA, UK, Canada and Australia.

Table 1. Livestock guarding dog breeds and country of origin (from Rigg 2001a). Bold type indicates breeds of dog used outside the country of origin.

COUNTRY OF ORIGIN	DOG BREED
Afghanistan:	Sage Kooch
Bulgaria:	Barachesto ovcharsko kuche (Barachesto) Karakachansko, kuche (Karakatchan)
Caucasus:	Kavkaskaya ovcharka (Caucasian Shepherd Dog, with Georgian, Armenian, Azerbaydjan and Dagestan varieties)
Croatia:	Tornjak, Croatian Guard Dog
France:	Patou des Pyrénées (Great Pyrenees) Briard, Alpine Shepherd Dog
Greece:	Elinikos Pimenikos (Greek Shepherd Dog)
Hungary:	Komondor, Kuvasz
Iran:	Sage Mazandarani
Italy:	Maremmano-Abruzzese (Maremma) Bergamo Shepherd Dog
Kirgizia:	Kirgizkaya ovcharka (Kirgizian Shepherd Dog)
Mongolia:	Buryato (Mongolian Livestock Guarding Dog)
Morocco:	Aidi (Atlas Guard Dog or Chien de l'Atlas)
Nepal and northern India:	Bhotia (Himalayan Mastiff)
Poland:	Owczarek Podhalański (Tatra Mountain Dog or Goral)
Portugal:	Cão de Castro Laboreiro, Cão da Serra da Estrela, Rafeiro do Alentejo
Romania:	Ciobanese romanesc Carpatin (Romanian Shepherd Dog), Ciobanesc romanesc Mioritic (Mioritic Shepherd Dog)
Russia:	South Russian Ovtcharka, Stredneaziatskaya Ovcharka (Central Asian Shepherd), Iounjnorousskaia Ovcharka (Central Asian Shepherd)
Slovakia:	Slovenský čuvač (Slovak Chuvatch, Liptok)
Slovenia:	Krasky Ovcar (Kras, Karst or Istrian Shepherd)
Spain:	Pyrenean or Navarre Mastiff, Mastin Español (Spanish Mastiff), Perro de Pastor Mallorquin
Switzerland:	Great Swiss or Swiss Grand Bouvier, Bernese Mountain Dog or Bouvier
Tadjikistan:	Dahmarda (Tadjikian Mastiff)

Tibet:	Do-Khy (Tibetan Mastiff), Tibetan Kyi-Apso
Turkey:	Akbash , Kangal Kopegi, Sivas Kangal or Karabash (Anatolian Mastiff or Shepherd Dog) , Kars Dog, Kurd Steppe Dog
Turkmenistan:	Alabay Koyunchi, Chokcha (Turkmenian Shepherd)
Uzbekistan:	Torkuz Sarkangik
former Yugoslavia:	Macedonia Sharplaninatz (Yugoslavian Shepherd Dog)

All breeds of LGDs have a similar placid nature, are non-predatory with livestock, have protective rather than herding instincts, form strong social bonds with livestock and will actively discourage other canids, other animal species that are identified as intruders, and unknown humans, from coming near 'their' flock (Parker 1978, Miller 1991, Coppinger and Coppinger 1993).

4.1 Most Common Breeds of LGD Used Around the World

Five breeds of LGD; the Akbash, Anatolian, Great Pyrenees, Komondor and Maremma and two rare breeds, the Kuvasz and the Sharplaninatz, are now found in several countries, outside their country of origin, guarding livestock.

4.1.1. Akbash



Akbash guarding sheep. Photo: Phylis Airth www.whitelands.com/akbash

Akbash were imported to the USA from Turkey in 1978 for livestock protection. By 1986 it was considered one of the most successful LGD breeds for protecting livestock in the USA. The USDA Animal Damage Control Program now recommend it as one of the best three breeds, less aggressive to people than many other LGD breeds (Andelt 1992) but very aggressive to wild predators and intruding dogs. It is more heat tolerant than heavier, more massive breeds (Taylor 1998b). The Akbash is the breed of choice to protect sheep and goats in fenced pastures and on rangelands in the USA (Andelt 1999a). This breed is not yet available in Australia for use as a livestock guard.

4.1.2 Anatolian (Karabash)



Anatolian with a flock of lambing ewes.

Photo: www.anatoliandog.org/history.htm

The Anatolian Shepherd has a history of over 6000 years in the arid Anatolian Plateau region of Turkey and Asia Minor. It has a medium length coat and coarse, usually light coloured hair allowing for effective cooling of the body while still insulating. Males are normally 60+ cm at the shoulder and 70–75 kg and can run fast, reaching speeds of 75 km/h. Anatolians can survive and work for prolonged periods with minimal water and food. They have good eyesight, sharp hearing and an excellent sense of smell. Anatolian Shepherds will deter foxes *Vulpes vulpes*, coyotes *Canis latrans*, wolves *Canis lupus*, bears *Ursus* spp. and mountain lions *Felis concolor* in both rangeland and pasture situations in the United States (Marker unpublished report cited in Rigg 2000a). This breed is available in Australia for use as an LGD.

4.1.3 Great Pyrenees



Great Pyreneean protecting sheep and goats. Photo: www.rps.uvi.edu/AES/Animal/Livestock_Guard_dog.html

Great Pyrenees are native to the Pyrenees mountains of France and Spain. They have a massive skull and floppy ears, reminiscent of mastiffs. They commonly have tan or grey markings on the head (Taylor 2000) but are predominantly white. They are rarely aggressive to humans (Hansen and Bakken 1999). No incidents of aggression towards people have been reported by US producers that use Great Pyrenees as LGDs (Andelt 1992; Green *et al* 1984). Also, fewer Great Pyrenees than Komondors, Akbash or Anatolians injured livestock (Green and Woodruff 1988). This breed is available in Australia for use as a livestock guard.

4.1.4 Komondor



Komondor. Photo: www.Lgd.org

The Komondor is an ancient breed, descended from the Owtcharka that was taken to Hungary (Puszta region) by invading Magyars. Animals were imported to the USA in the early 1960s. The Komondor's dense white coat protects it from the weather and predators. Males average 80 cm tall weighing 50–61 kg and females 70 cm, weighing between 36–50 kg. For their size, they are fast, and agile. Many dogs are not fully mature until 3 years old. External parasites can be a problem due to the heavy coat. McGrew and Blakesley (1982) described the breed as intelligent, stubborn, aggressive and shy with a low inclination to chase. Andelt (1992) and Woodruff and Green (1988) reported Komondors were more aggressive to people than Akbash, Great Pyrenees or Anatolians. It was concluded that Komondors might be considered for remote areas or where livestock theft is a concern but are not suitable in areas where encounters with humans are likely. Komondors may be less useful than other LGD breeds because of their strong site fidelity (McGraw and Blakesley 1982). This breed is not yet available in Australia for use as a livestock guard.

4.1.5 Kuvasz



Kuvasz with sheep and a dog-tolerant donkey. Photo: G Darrett www.kuvasz.info/2kuvasz

The Kuvasz, descended from the Arabian wolf, is considered the ancestor of many of the LGD breeds seen today. Archaeological evidence places a dog of Kuvasz appearance in what is today North Iraq in 6600 BC, although the Kuvasz is thought to have existed as early as 9000 BC. The breed borrowed its name from the ancient farmers of Russia, the Chuvash, (Rigg 2001a). This breed is not available in Australia for use as a livestock guard.

4.1.6 Maremma



Maremma protecting a flock of ewes. Photo: D Jenkins

The Maremma (Maremmano-Abruzzese) originated in two sheep rearing regions in central Italy, the Maremma, a lowland region of plains and Abruzzi, a region of mountains. They have been used as guards for livestock for more than 2,000 years. In Italy Maremmas are still used within the traditional pastoral system. Each summer sheep flocks are moved from the Maremma lowlands to feed on the more lush pastures of the mountainous Abruzzi, accompanied by their Maremmas.

A flock of 3000 milking sheep in this region of Italy would commonly be divided into 10 sub-flocks, supervised by up to 15 shepherd/milkers and each sub flock of 300 sheep would have at least 3 Maremmas guarding it. Since milking sheep are penned at night, and the dogs stay with the sheep, the shepherds and their Maremmas have a more interactive relationship than shepherds and Maremmas with non-milking Italian flocks managed in a 'range' situation. Currently, there are about 7000 Maremmas in Italy.

Maremmas are large, strong, agile dogs that are intelligent, courageous and rarely aggressive to humans. Dogs are 65–73 cm at the shoulder and weigh 35–45 kg, whilst bitches are smaller, 60–68 cm and weigh 30–40 kg. The coat is all white or sometimes with a little shading of ivory or pale fawn. There is black pigmentation of the lips, nose and eye rims (Rigg 2001a; Miller 1991). Maremmas are the most commonly used LGA in Australia, used to protect mainly sheep but also other animals such as goats and poultry.

4.1.7 Sharplaninatz



Sharplaninatz. Photo: <http://neshwill.homestead.com/>

Sharplaninatz are rare outside their homeland of Yugoslavia. It is an ancient breed from the mountain region of south eastern Yugoslavia (Sharplanina mountain range) thought to be descended from Greek Molossian dogs and Turkish LGDs and still widely used to protect flocks from predators in Yugoslavia. Sharplaninatz are slightly smaller than many LGD breeds (males 61 cm, 35–45 kg and females 57 cm, 30–40 kg) but are very strong for their size. They have a double coat, the outer coat is long and straight, commonly iron grey in colour (Rigg 2001a). This breed is not available in Australia for use as a livestock guard.

4.2 Overseas experiences with LGAs

4.2.1 Levels of predation, financial losses to international livestock industries and adoption of LGDs for predator control overseas

NORWAY: Currently, about 70,000 head of sheep are lost annually to predation by wild carnivores (brown bears, lynx, wolves, and wolverines) during the three month summer grazing period. The Norwegian government is restoring predators in many areas and at the same time

evaluating the effectiveness of LGDs for protecting livestock in predator restoration areas and other areas where livestock losses are high during the grazing season (Hansen & Bakken 1999; Hansen and Smith 1999).

FRANCE: The European Lynx is being reintroduced into the Jura region of France. This has coincided with increased predation on sheep/lambs in identified 'hot-spots'. In other areas attacks are sporadic and do not warrant spending large sums of money on predator control methods. LGDs are not normally used in the Jura but the French Ministry of Environment has decided to subsidise the cost of introducing the use of LGDs on to farms to protect sheep in the predation hot-spots (Stahl & Vandel 2001).

RUMANIA: Rumania still has good populations of bears, wolves and lynx. A positive correlation has been shown between predation of sheep and larger flocks of sheep inadequately supervised by too few, often inadequately trained, LGDs. The Carpathian Large Carnivore Project, supported with funds from ecotourism, is planning to support improving the quality of training and increasing the population of LGDs for shepherds in Rumania (Mertens et al 2001).

SWITZERLAND: Following reintroduction of wolves into the Swiss Alps attacks on sheep generated considerable public hostility. The Swiss Wolf Project in order to solve these conflicts is funding the introduction of livestock guarding animals. The difficulty is to convince the farmers to take steps to protect their sheep. The farmers feel by instigating protective measures they accept the presence of the wolves. Some farmers have agreed and 25 LGDs (mostly Great Pyrenees) are in place and 8 shepherds have been employed to advise and instruct farmers on livestock guards in predation hotspots (Weber 2000).

SLOVAKIA: In a bid to protect livestock whilst at the same time conserving large carnivores in Slovakia, attempts are underway to renovate the traditional use of LGDs. LGDs are bred and trained in a central facility and issued to farmers who have been educated and trained in using and maintaining LGDs (Rigg 2001b)

UNITED STATES OF AMERICA: Wolf reintroductions into national parks in the United States have also met with considerable public hostility and in many cases non-lethal means of controlling the relatively low levels of annual predation on livestock have been of limited success. Where LGDs were in use, several cases of the LGDs being killed by attacking wolves have been reported, even when several LGDs were present at the time (Bangs & Shivik 2001).

In 1985, 1986 and 1987 financial losses in the United States sheep industry were \$69, \$72 and \$83 million, respectively (Franklin and Powell 1994). The estimated financial loss to United States sheep producers in 1994, due to predation on their sheep and lambs was \$17.7 million (National Agricultural Statistics Service 1995). In the 17 western states of America, predation on sheep/lambs and calves by wild predators (mainly coyotes), feral dogs and domestic dogs has been calculated to cost the United States sheep and cattle producers approximately \$19 million and \$20 million, respectively, per year (Andelt 1996).

In 1986, 7% of Colorado producers used LGAs, by 1993 this figure had increased to 68% (Andelt & Hopper 2000). In 1998, analysis of 8,451 responses from American sheep producers in a nation-wide survey on the use of various forms of non-lethal predation control revealed that 20% of producers were using animals for guarding livestock against predation by wild carnivores and/or marauding domestic dogs and this figure is increasing (Connolly & Wagner 1998). Producers in some states receive financial incentives to incorporate livestock guarding animals into their livestock operations (Bergman et al 1998).

Flock sizes where LGDs are used are variable in the USA as they are in Australia. In the US, about 22% of producers had flocks of 50 animals or less, 49% had 51–500, 18% had 501–1000 and 11% had >1000 head (Green et al 1984).

Property sizes where LGDs are used are also variable, 18% grazed 16 ha or less, 20% grazed 17–65 ha, 20% grazed 66–259 ha, 13% grazed >259 ha (Green et al 1984).

Coyotes are the major predator in the USA, followed by domestic or feral dogs, bears, mountain lions, bobcats, wolves, foxes and golden eagles (Andelt 1999b).

4.2.2 Factors concerned with the selection, training and use of LGDs

The decision by a producer to incorporate LGDs into a livestock enterprise has to be accompanied by a major commitment of time and effort on behalf of the producer. The more time and effort put into training young dogs and attention to their care and well-being following training, the better the outcome. However, producers should also appreciate that some individuals of all breeds of LGDs never become effective livestock guards. Once identified, these dogs should be removed and replaced with a new recruit (Green & Woodruff 1999).

Under some circumstances investing in an LGD is all that is required to solve a predation problem, but in the majority of cases the use of LGDs is an adjunct to conventional lethal and non-lethal methods used to counter predation by wild carnivores (Green & Woodruff 1999; Green et al 1994).

Livestock guarding dogs have been used in the USA since the mid 1970's mostly for protecting sheep and goats from coyotes. However, they are also effective in protecting livestock from predation by black bears, mountain lions, marauding domestic dogs and wolves (Green & Woodruff 1999).

4.2.2.1 USA Federal and State Government subsidised projects to encourage the use of livestock guarding dogs

As part of a cost sharing exercise between producers and the state government for reducing predation on livestock, North Dakota introduced a 50% subsidy (up to a limited maximum) to help producers purchase LGAs and thus enable them to become more self-reliant in their predation control. The scheme proved popular with 54 producers purchasing LGAs for the first time with dogs (Great Pyrenees) being the favoured choice, followed by donkeys and llamas (Bergman et al 1998).

In another scheme, USDA Animal and Plant Health Inspection Service (APHIS) Animal Damage Control (ADC) Livestock Guarding Dog Program issued one LGD to each of 100 producers to assess the effectiveness of this method of predation control. Within the period of the study, most of the producers rearing their sheep in rangeland situations, noting the effectiveness of the dogs, had purchased additional dogs at their own expense (Green et al 1994).

4.2.2.2 Selecting an LGD

LGDs need to be intelligent, alert, confident, work instinctively and independently whilst protecting the flock. An LGD should investigate and aggressively confront intruders but must also not wander, be attentive to the flock and not harm them. The behaviour of mature LGDs reflects their training as a puppy and heredity. LGDs mature slowly, Komondors and Anatolian Shepherds do not start to show signs of behavioural maturity until they are about 18–36 months old whilst with Great Pyrenees behavioural maturity becomes apparent a little earlier, at about 12–18 months old. Young dogs of all breeds are playful and irrational and should not be expected to perform as well as an older mature, experienced dog (McGrew & Blakesley 1982; Green & Woodruff 1999).

In Idaho and North Dakota, most producers use Pyrenees (57%) followed by Komondors (18%), Akbash (8%), Anatolian Shepherds (7%), Maremmas (3%) and others (7%) (Bergman et al 1998; Green & Woodruff 1999) whilst in Colorado Akbash are the favoured breed over Great Pyrenees and Komondors (Andelt 1996; Andelt 1999).

The different breeds' ability to protect livestock was similar but there was a difference between the breeds in aggression towards people and in injuring livestock. More Komondors bite people than Great Pyrenees, Akbash or Anatolian Shepherds and fewer Great Pyrenees injure livestock than Komondors, Akbash or Anatolian Shepherds. Before purchasing an LGD the breed temperament should be considered and the more aggressive breeds not used in situations where there is the possibility of interactions with the public. In situations in the USA where the local predators were not coyotes or foxes but bears, mountain lions or wolves the more aggressive breeds may be more effective. In Australia, where the major predators are dingoes rather than foxes, the more aggressive breeds may also be more effective (Andelt 1996,1999; Bergman et al 1998; Green et al 1984; Green & Woodruff 1999; Hansen & Bakken 1999; Parker 1978)

4.2.2.3 Availability of LGD breeds in the USA

A number of breeds of LGDs are available in most sheep rearing areas of the world (see Section 4 above). These include the Maremma, the Sharplaninetz, the Anatolian Shepherd, the Komondor, the Great Pyrenees, the Kuvasz and the Akbash (Green & Woodruff 1999). In addition to these recognised breeds from Asia and Europe, the Navajo Indians in Arizona in the USA use a variety of mongrel dogs to protect their sheep. These Navajo dogs have not been selected over many centuries for their guarding characteristics. Their ability to protect the Navajo livestock seems to be the result of the way they are reared and trained (Black 1981; Black & Green 1985).

4.2.2.4 Training LGDs

Most producers train new LGDs themselves following purchase of untrained puppies or training puppies producers may have bred themselves. Some breeders sell puppies that have already been socialised with sheep (Green & Woodruff 1999).

Briefly, the training of new LGDs consists of weaned puppies being separated from littermates at about 8 weeks and each contained in a small, escape-proof pen with three or four lambs. The puppies and lambs are kept under these conditions for minimum of 12 weeks to allow the puppy time to develop a strong bond with the lambs. The puppy should be regularly checked in the first few days to ensure it is coping but human contact with the puppy should be kept to a minimum to avoid bonding with humans. Nevertheless, the pups should have some handling to ensure they are not apprehensive of people and can be caught and handled as necessary later (Green & Woodruff 1999). A study in Canada compared the effectiveness of LGDs reared with, and suckled on, sheep and goats to LGDs reared by their natural mothers (Aarons 1981). The results of the study indicated no difference in the ability of the dogs from either group in becoming effective LGDs.

Care is needed when introducing young LGDs to new surroundings and to new groups of adult sheep to ensure the dog will not be frightened by some unexpected event or intimidated by the sheep (McGrew & Blakesley 1982). Such events may have a serious adverse effect on the ability of the dogs to work. If the training goes well the dog will be able to start work on its own by about 7–9 months old. During the first working year the dog is still reaching behavioural maturity and producers commonly find their dogs play, rather roughly at times, with lambs but they settle down and the protective behaviour of the dogs improves with age and maturity (McGrew & Blakesley 1982; Green & Woodruff 1999).

The Navajo Indians in Arizona successfully use crossbred mongrel dogs as LGDs to protect their sheep and goats against coyotes. The effectiveness of these dogs is thought to be associated not with instinct developed through many generations of selective breeding but by the way they are reared and trained. The term 'trained' is a loose interpretation and consists of a Navajo time-tested method of bonding the dog to the livestock with minimal human interference (Black 1981; Black & Green 1985).

The LGDs of the Navajo are never handled by their owners. Like the LGDs of non-Navajo, Navajo dogs do not herd the sheep but just protect them from predators. The dogs live in and around the sheep/goat enclosures and their only shelter is what they make for themselves (shallow excavated depressions). These excavations are either in the sheep/goat enclosure or next to the enclosure fence. The dogs were fed once/day either at the livestock enclosure or called to the house, returning to the sheep immediately after eating. Bitches whelp either in or next to the sheep/goat enclosure and remain there with the puppies in physical, olfactory and auditory contact with the livestock until they are weaned and as soon as they are sufficiently mobile the puppies accompany their mother and livestock to the pasture. Some Navajo, if they acquire a puppy from elsewhere, will restrain it in the livestock enclosure with the sheep and goats to acquaint the dog with the animals for a few days. Young dogs that stray from the livestock enclosure are usually chased back with sticks and stones and some are physically carried back to the enclosure and/or secured there for a few days if they wander often. The Navajo attitude is that puppies are best trained to guard livestock by their experienced maternal bitch. Navajo LGDs stay with the stock almost continuously except for the time they may go for a drink. In hot weather the dogs and sheep lie together in the shade of trees. Several dogs are commonly used to protect a flock (e.g. a flock of 60 sheep and 20 goats was protected by four dogs that had lived their entire life with those sheep and goats). Navajo dogs that continuously worry sheep or kill a sheep were usually shot (Black 1981; Black & Green 1985).

4.2.2.5 Influence of gender on the effectiveness of LGDs

No gender difference in LGD success has been identified based on data collected from closely monitoring 763 LGDs. Problems mainly arise with male LGDs leaving their paddock if a producer has mixed gender LGDs on his property and one of the females elsewhere is on heat. Some females on heat may also wander from their flock. However, if all the males in a mixed gender group of LGDs are neutered there are minimal wandering problems. The study also demonstrated no significant differences in the performance of intact versus neutered dogs. The recommended time for desexing males is when they are about 9 months old and when females are about 6 months old before their first oestrus. No evidence exists to suggest desexing reduces the aggressiveness of either sex towards intruders (Green & Woodruff 1999).

4.2.2.6 Effectiveness of LGDs in open range compared to fenced paddocks

In two studies one year apart, it was shown that producers without LGDs, whether operating on open range or in fenced paddocks, lost between 2.1 and 5.9 times more lambs and ewes per year to predators than producers who used LGDs. The proportions of stock killed on properties where LGDs were used decreased annually as LGDs became more proficient in their work (Andlet & Hopper 2000). Effectiveness of LGDs particularly against coyotes did not differ between fenced pasture and open range operations (Coppinger et al 1988; Green & Woodruff 1990; Andelt & Hopper 2000) but against bears and mountain lions LGDs were more effective in fenced pastures.

Management practices on open rangelands and fenced paddocks differ and this in turn necessitates different strategies in the use of LGDs in each situation.

Open Rangeland

About 27 % of USA producers graze sheep on open rangelands for part of the year. Fences are rarely encountered on open rangelands allowing sheep the opportunity to disperse over a wide area but to control this dispersal there is often a herder/shepherd in attendance. The shepherd controls the grazing pattern and provides some protection for the flock. The LGDs must recognise the sheep to be protected and be able to readily adapt to constantly changing grazing areas and territory. Since the LGDs remain unsupervised with the sheep much of the time they must not behave in a way that causes the sheep to scatter (Green & Woodruff 1999).

Socialising the sheep with the LGDs before entering the rangelands is important. This is achieved by confining the dogs with the flock in a fenced paddock from one to up to six weeks before entering the rangelands. If this is not done the sheep will be frightened of the dogs and scatter whenever the dogs try to remain near them and the dogs will not recognise 'their' sheep. Eventually, if the sheep persist in scattering, the dog may lose interest in the sheep (Green & Woodruff 1999).

Analysis of producer ratings did not identify a difference between the effectiveness of LGDs against coyotes in either fenced pasture or rangeland situations (Andelt 1992). Against black bears and mountain lions, analysis of producer ratings indicated the dogs performed better in fenced paddocks than on the open range (Andelt 1992). However, field data of Andelt and Hooper (2000) indicated the converse for coyotes. Producers using LGDs on open rangelands had higher predation due to coyotes than producers with LGDs in fenced paddocks. This may reflect higher coyote populations and more sheep (larger flocks) in the rangelands but producers thought each LGD on the open range saved a larger value of sheep than dogs working in fenced situations.

LGD performance is similar with large or small flocks of sheep but 2 or more dogs provide better protection than one on its own. Two examples cited in Green et al (1994), in open rangelands reported excellent results when a flock of 1600 ewes and a flock of 960 ewes with 1193 lambs were each protected with 6 LGDs. Producers report improved protection against coyotes when additional LGDs are used, but too many dogs become unmanageable.

In Norway, the effectiveness of Great Pyrenees was studied in open range grazing conditions both with and without a shepherd in attendance. The nature of the country in which the sheep grazed, steep hills and extensive forest, and the habit of the sheep to separate and not flock, particularly if danger threatened, contributed greatly to the LGDs being ineffective in reducing predation in the open range in Norway (Hansen and Smith 1999).

Fenced Paddocks

More than 80% of producers in the USA raise their sheep in fenced paddocks for all or most of the year (Green & Woodruff 1999). Livestock losses to predators (particularly coyotes) on fenced pasture, compared to open rangeland, is less but the results can be severe (Green & Woodruff 1999). Smaller producers with fenced grazing commonly use LGDs. As the sheep are confined by fences scattering is not such a problem as on the rangeland and consequently LGDs are trained differently. The most important aspect of the training of an LGD working in a fenced paddock is teaching the dog to stay in the paddock with the sheep and not to wander. When young, the socialisation training with lambs is the same for rangeland and fenced paddock dogs. Great care has to be taken with introducing LGDs 'in training' to new and unfamiliar paddocks and time must be allowed for the dogs to become familiar with the area (McGrew & Blakesley 1982; Green and Woodruff 1999). If the dog leaves the paddock it should be returned promptly each time until it learns what is expected (Green & Woodruff 1999).

In a trial of the effectiveness of Great Pyrenees as LGDs in Norway to control predation, the only situation where they were effective was in 1 km² fenced paddocks, where the scattering tendencies of the sheep could be contained (Hansen & Smith 1999). A trial of Komondors in the US, protecting sheep against coyotes, in fenced paddocks (65–330 hectares), led to a 60% drop in predation levels post introduction of the Komondors, compared to pre-introduction predation levels (Linhart *et al* 1979).

Some dogs will leave a paddock for short times investigating and scent marking the territory nearby. So long as these sorties do not cause problems with neighbours, a buffer zone of scent marks may be beneficial in deterring predators (Green & Woodruff 1999). In situations where the paddock is near a road or a neighbour is using lethal predator control methods it is important LGDs never leave their paddock. Fences may need to be modified to ensure LGDs cannot get through or the dogs need to be fitted with a device that stops them escaping. In the photo below an Australian Maremma is wearing a triangular collar made from plastic water pipe. This lightweight, cumbersome structure effectively stopped the dog from escaping through fences and the dog soon became used to wearing the collar.



An Australian Maremma fitted with a triangular collar constructed of plastic water pipe to stop it escaping through fences. Photo: D Jenkins

4.2.2.7 Effectiveness of LGDs over time

The active working life of a LGD may be as long as 10 years (McGrew & Blakesley 1982) but there is up to about a 50% chance of a producer having to replace a LGD during the first two years and about 6.3% of LGDs are lost annually thereafter. In America, the causes of death of LGDs before reaching adulthood are hit by vehicles (23%); maliciously shot (23%); ill health (18%); accidents in the field (9%); untrustworthy (destroyed) (4%); unknown reasons (23%). A producer can minimise these losses by taking a number of practical precautions, such as alerting neighbours of the intention of using LGDs, not using LGDs near busy roads, being alert to the presence of poison baits, traps, snares and other potentially lethal methods of predator control used locally, ensuring dogs are safely secured in the back of utilities when being transported (Lorenz *et al* 1986; Green & Woodruff 1999).

In a study of producer assessments of the effectiveness of LGDs over time (1987 or 1988 until 1993), in two areas in the USA, 82% of producers reported that the performance of their LGDs was

the same or improved in 1993 compared to the previous years (Green et al 1994). A study by McGrew & Blakesley (1982) showed clearly that over time LGDs are able to adapt and improve their guarding ability. Although, 18% of producers thought the effectiveness of their dogs had decreased in 1993, compared to the previous years, most of them regarded the LGDs as an asset to their livestock operation. Most producers attributed the reduced effectiveness of their LGDs to increased coyote numbers rather than any reduction in the ability of their dogs (Green et al 1994). Similar positive attitudes of producers towards their LGDs were reported by Andelt & Hopper (2000)

4.2.2.8 Cost effectiveness of using LGDs

The purchase price of LGDs is an important consideration for a producer particularly in view of the fact that around 50% of dogs are dead within the first two years, before they have become effective. In addition to the purchase price there are other financial considerations in that first two years and some annually thereafter:

- the shipping costs from breeder to new owner
- annual cost of feed
- annual veterinary costs
- cost of kilometres driven annually to care for and work with the dog
- value of damage done by the dog
- time training and working with the dog
- extra time spent/year mustering if the dog causes problems

Despite these potential economic disincentives, the opinion of the majority of producers in several surveys was positive, with up to 95% considering that LGDs were an economic asset (Andelt 1992; Andelt 1996; Andelt 2001; Andelt & Hopper 2000; Green & Woodruff 1999; Green et al 1984). It is debatable if an LGD would be financially worthwhile during the first year when all the setting-up costs are factored in, but in subsequent years when the dog is behaviourally mature and only the maintenance and running costs need be considered the data suggests they are a very cost effective method of 24 hour/day predator control. After the first year an LGD costs between \$286 and \$285 each year to maintain. In the examples of annual savings by producers who incorporated LGDs in their livestock operation (listed below and those cited in Andelt 2001), it is clear that LGDs, for the majority of producers, more than recouped the annual outlay on maintenance in the head of livestock saved from predation.

The following is a series of examples cited by Andelt (1996):

- In a survey of 36 producers in North Dakota, predation was reduced by 93% following the introduction of LGDs into their livestock enterprises.
- In a study of 37 producers in 1983, 73% of the producers with LGDs experienced estimated average annual savings ranging from \$180 to \$14,487/producer but 27% experienced annual losses of \$95 to \$3405. In 1986, 400 producers were surveyed in an extension of the 1983 study and 82% reported LGDs were an economic asset.
- In a survey of 40 producers in Idaho, LGDs saved an average of 68 head of sheep/producer, valued at \$3836.
- In a survey of 12 producers in Kansas, 24 LGDs saved \$27,000/year in sheep losses.
- On a study site in Montana, LGDs and a range of lethal control measures were used for coyote control. Only the LGDs were able to stop the predation.
- Producers in Colorado estimate that each LGD saves them an average of \$3216/year/producer.

The annual combined sheep and lamb losses for the state of Colorado in 1994 were calculated to be worth \$2.2 million. The State Department of Statistics calculated predators killed 2.0% of ewes and 11.4% of lambs in Colorado in 1995, figures similar to the level of individual losses experienced by producers who did not use LGDs. Producers in Colorado using LGDs estimated that their dogs saved them \$891,440 during 1993. It was calculated that this saving had about a 2.7 ‘multiplier effect’, suggesting that the LGDs added about \$2.4 million to the economy of Colorado (Andelt & Hopper 2000).

4.2.2.9 Non-financial positive outcomes from incorporating LGDs in a livestock operation

Non-financial positive and negative outcomes from using LGDs identified by producers were:

- Peace of mind, not worrying about the next attack
- Saved time for other tasks and family, because no need (or reduced need) to spend time on other methods of predator control
- Reduced reliance on other predator control methods
- Humane method (good public acceptance)
- Selectivity (targeted control)
- Family and property protection
- Early warning of the approach of predators/intruders
- Reduced labour
- Increased utilisation of paddocks not used because of high predator pressure
- Opportunity to increase flock size due to extra available grazing
- Increased self reliance on managing predator problems

Nevertheless some dog owners were worried about the dog’s safety; unwanted breeding; pups being too playful with sheep, dogs roaming, dogs chasing wildlife or dogs occasionally biting people.

(Andelt 1992; Andelt 1996; Green & Woodruff 1999; Green et al 1984)

4.2.2.10 Effectiveness of LGDs against various species of predator in the USA

The relative effectiveness of LGDs against the range of predators that kill livestock in the USA (coyotes, foxes, black bears, grizzly bears, mountain lions, bobcats, wolves and domestic dogs) has not been rigorously evaluated. Coyotes are smaller than LGDs and usually avoid a direct encounter and about 95% of LGDs are aggressive towards coyotes (McGrew & Blakesley 1982). Fewer LGDs are aggressive towards domestic dogs (74%). Foxes are thought to respond similarly to LGDs as coyotes by avoiding confrontation. Interactions with wolves are unpredictable. Some wolves avoid the area inhabited by LGDs but others will posture around and fights with resident LGDs may develop. Typically with bears the LGDs will bark around the bear and the bear leaves the area. Grizzly bears, being larger, are less intimidated by LGDs than black bears. Physical contact between LGDs and bears is rare. Data regarding encounters between wild felids and LGDs are rare. It is likely bobcats would avoid the area frequented by an LGD whilst mountain lions may be less inhibited (Andelt 1996; Andelt & Hopper 2000; Green & Woodruff 1999; McGrew & Blakesley 1982).

4.2.2.11 Reasons for lack of, or reduced, success of LGDs in the USA

Apart from an individual LGD simply not being any good as a livestock guard, other possible reasons for lack of effectiveness include:

- Lack of producer knowledge/information on how to select, train and manage LGDs.
- Increase in population of predators.

- Predators developing hunting strategies that the LGDs cannot counter, e.g. several predators attacking at one time when only one LGD is in attendance; several predators feinting attacks over time and tiring out the LGD rendering it eventually incapable of effectively protecting the flock through fatigue.
 - Too large a paddock.
 - Too much cover (rocks/bushes/small hills) allowing a predator the opportunity to close-in on livestock unseen by the LGD.
 - Livestock not flocking when threatened but remaining spread about the paddock thus creating great difficulty for the LGD to adequately protect all individuals.
 - LGDs not well bonded with the livestock to be protected.
 - LGDs killed by predators
- (McGrew & Blakesley 1982; Andelt 1992; Andelt & Hopper 2000)

5. Alpacas and Llamas

Alpacas and llamas are both South American camelids. They are hardy, intelligent and gregarious and have evolved strong herding instincts. Males and females have strong protective instincts towards each other and especially their young together with an innate dislike of canids (Richards 2002). It is their dislike of canids, ability to bond with domestic livestock and protective instincts that have identified alpacas and llamas as potentially useful livestock guardians.

The origins of alpacas and llamas are unclear. Naturally, they are confined to the west and southernmost parts of South America, but in recent times alpacas and llamas have been imported into Australia for use in the Australian fibre industry. Alpacas and llamas are only known as domesticated animals and it is thought the domestication of both species may have begun between 5500–4200 BC (Clutton-Brock 1981).

In South America they have many uses, as a source of milk, meat, fibre and skins and llamas are also used as pack and draught animals. The most recent use for alpacas and llamas is as guards for livestock and poultry. The species guarded does not seem to matter, once llamas or alpacas have established a paddock as ‘their territory’ and bonded with the livestock or poultry they are to protect, they work hard to ensure the paddock is clear of canids. Both species are easy on fences needing the same fencing as sheep to contain them. Their management is similar to that of sheep, they need vaccination against clostridial disease and regular drenching and, depending on the sort of substrate they are living on, their toe nails may need occasional trimming. They eat grass and hay and llamas also like to eat coarse food such as rushes and introduced exotic plant pests of Australia, serrated tussock and blackberry bushes.

5.1 Alpacas



Female alpaca with young (cri). Photo: D Jenkins

Alpacas are smaller than llamas weighing 50–70 kg and reaching a height of about 1.4 metres. Alpacas should be shorn annually. In South America they survive best at high altitudes (above 3600 m), but they also do well in the areas of south-eastern Australia associated with the Dividing Range. They may be brown, black or white or mixed colour. They have a gentle inquisitive temperament but have an inherent intense dislike for canids. They are good guards for livestock especially against foxes but their ability to chase canids may be hampered by their abundant fleece and their woolly faces may partially obscure their vision, reducing their efficiency in early detection of canids advancing on a flock.

Alpacas are normally docile towards humans and other animals they do not regard as threatening and are protective towards sheep or goats with which they have ‘bonded’, particularly when threatened by a canid predator. Alpacas will tolerate domestic dogs they recognise but will aggressively repel those they do not recognise. Alpacas have good eyesight and standing tall are able to scan wide areas for any animal approaching its paddock. They are normally silent, but if alpacas observe a predator approaching the flock they will quickly move towards it emitting a loud squeal that may also alert the producer to the presence of a potential threat to the stock. As predators usually avoid confrontations they move away but may be pursued by the alpaca. If an alpaca corners a predator the alpaca will kick and stamp on the predator, sometimes killing it.

5.1.2 Specific points to note if incorporating alpacas into a livestock operation (Richardson 2002)

5.1.2.1 Maturity and bonding

- The protective instincts of alpacas are not fully developed until they are about 18 months to two years old.
- Ideally, it is best to introduce alpacas to a flock of pregnant ewes or goats 4–6 weeks before the onset of lambing or kidding to allow time for the sheep and the alpaca(s) to get used to each other and time for bonding. Even if lambing or kidding has begun it is still possible to introduce alpacas and have good results.

5.1.2.2 Gender considerations

- Farmers should use fully-grown castrated male alpacas to protect mobs of lambing ewes or kidding goats.
- Entire males should be avoided because they commonly mount the females in the flock they are protecting causing stress, injuries and the possibility of fibre contamination.
- Castration of males before they reach two years old should ensure conflict between different castrated adult male alpacas does not occur.

5.1.2.3 Number of alpacas versus paddock and flock size

- One alpaca can adequately protect 100 sheep in a paddock of about 20 hectares.
- Several alpacas may be needed in a paddock that is hilly or has numerous obstacles to a clear view, but three or more alpacas in a mob may form a species group and ignore the sheep.
- Two alpacas per paddock are commonly used but a lone alpaca will work as well. Single alpacas in adjoining paddocks may spend much of their time socialising with each other and not concentrating on the animals they are supposed to protect.
- Successes in reducing lamb losses to eagles, crows, wild dogs and foxes have been reported when running several alpacas with large mobs of lambing ewes.

5.1.2.4 Parasites and disease

- The defecation behaviour of alpacas and the lack of fibre around the anus and urinogenital area contribute greatly to low parasite burdens in alpacas. However, if grazed with livestock alpacas can become infected with intestinal parasites of livestock and therefore should be subjected to the same drenching regime as the livestock they are with.
- Alpacas are not subjected to fly strike and do not require mulesing or crutching.
- Alpacas should be vaccinated with 5 in 1 clostridial disease vaccine every 6 months and if they are running on soft ground their toenails will need occasional trimming.
- Alpacas do not contract Ovine Johnes Disease (OJD) but are susceptible to infection with Bovine Johnes Disease (BJD). However, as of June 2002 there were no known alpaca herds infected with BJD in Australia.

5.1.2.6 Environmental damage

- Alpacas are environmentally friendly, in respect of damage to the surface of the ground, because of their low ground hoof pressure (39 kPA) compared to other livestock (sheep, 82 kPA and cattle, 185 kPA).

5.1.2.7 Contamination of wool clip with foreign fibre

- Alpacas bonded to sheep always keep their distance. They will only make physical contact with sheep if forced to e.g. during yarding. Ideally alpacas should be separated from the sheep before yarding and 8 weeks before shearing. Since alpacas naturally do not shed their fibre the risk of contaminating wool with fibre is minimal. Alpacas need to be shorn annually. To minimise risks of fibre contamination at shearing, the alpacas should be shorn after all the sheep have been finished and the shed well cleaned afterwards.

5.2 Llamas



Adult llama Photo: D Jenkins

Llamas originate from the mountains of Peru and also thrive in the elevated regions of south eastern Australia associated with the dividing range. They are tall animals, reaching a height of 2 metres and weighing up to 200 kg. Their life span is 20–30 years with a useful working life of at least 15–25 years. They are inquisitive, quiet animals with a ‘laid back’ attitude. Shearing of llamas depends on the type of fleece they have, some moult not needing shearing but most are shorn biannually. Like alpacas, llamas are aggressive towards canids. Llamas have the advantage over alpacas of greater height, weight and speed that may make them more useful guards for livestock against wild dogs. The lack of fleece around the face of llamas combined with their height enables them to more easily detect intruders at greater distance than alpacas.

Llamas have been used in the USA for guarding livestock from the early 1980s. They bond well with sheep and goats and are considered most effective against coyotes, foxes and domestic dogs (Markham et al 1993).

Three United States studies have assessed the effectiveness of llamas in protecting sheep from predators, one based on field data (Meadows and Knowlton 2000) and two based on farmer assessments (Franklin and Powell 1994; United States Department of Agriculture 1996).

5.2.1 Influence of paddock and flock size on effectiveness of llamas in reducing predation

Meadows & Knowlton (2000) assessed guard llamas working with a range of flock and paddock sizes in Utah. The average flock size was about 300 animals (range 1–3200) and the average paddock size was about 80 hectares (range 0.5 to 1200 hectares). They compared two similar groups of farms (one group using guard llamas and the other not using guard llamas) over two lambing seasons. The predators in the area were black bears, mountain lions, common ravens, domestic dogs, red foxes and coyotes. Ninety two percent of all the sheep/lamb losses in the study were due to predation by coyotes, red foxes and domestic dogs. In the first year 128 head were lost in the group not using llamas and 42 lost in the llama-using group. In the second year the results in both groups were similar. The predation levels in the group of farms with llamas were similar to the

previous year whilst the predation levels on the group of farms without llamas had dropped. The authors speculated on a decline in predator population, changes in availability of other, easier to access, food sources for the predators and a threshold below which llamas are unable to further reduce predation. The authors did not consider predators changing their hunting strategy in the face of guard llamas. Despite the disappointing results in the second year, producers using llamas strongly endorsed them as a predation deterrent with producer approvals comparable to those associated with guard dogs. Llamas can be a useful adjunct to controlling livestock losses due to predation.

The study of Franklin and Powell (1994) was based on telephone interviews with 145 farmers using guard llamas across the United States and on-site visits to 29 sheep farms. About 70% of llamas in this study were gelded males. One llama protected on average between 250–300 sheep (range 4–2100). Average paddock size was 250–300 acres). Llamas averaged about 2 years old when introduced to sheep (most common age 6–11 months old) and none had had any previous experience of sheep. For 201 llamas, on their first introduction to sheep, the adjustment period was only a few hours for half and 80% were fully bonded by one week.

Before investing in a llama the producers had been losing an average of 26 sheep/year (11% of their flock) to predation (mainly by coyotes). After obtaining the llama, losses dropped to an average 8 sheep/year (about 1% of their flocks). Half the producers had had their losses reduced to zero. Eighty percent of the producers rated the ability of llamas to reduce predation losses as ‘very effective’ or ‘effective’. All producers also used other forms of predator control.

5.2.2 Points to note when using llamas as LGAs

5.2.2.1 Importance of age

- Llamas do not reach full protecting potential until 1–2 years old
- The age of llamas more than one year old does not affect their effectiveness to protect livestock.
- Llamas are weaned at 6–8 months old and gelded at 6–24 months old.

5.2.2.2 Importance of gender

- Intact males can cause problems trying to mate ewes
- Gelded males are more useful
- No difference between genders in the effectiveness to protect livestock. Females are rarely used because they are more expensive to buy than intact or gelded males.

5.2.2.3 Aggression

- Llamas may become over protective and cause difficulties when working the sheep.
- If hand feeding, llamas may become aggressive towards the sheep if the llama is crowded out by the sheep — solved by providing a food container for the llama set at a height that sheep cannot reach.
- Intact males may become aggressive to livestock.

5.2.2.4 Training

- Minimal training is required but sheep and llamas bond better when confined together in a small yard for 4–6 weeks, rather than in a large paddock.

5.2.2.5 Parasites and disease

- Llamas need to be wormed 2–4 times/year and vaccinated annually for clostridial diseases and tetanus.

5.2.2.6 Financial savings through investing in llamas

- Average annual savings for 86 US producers following the introduction of llamas to their livestock operation was \$1034. One producer estimated he saved \$20,000/year.
- Llamas are a cheaper option than dogs over time.
- Llamas have a working life of 10–15 years, despite the high purchase price of a llama and annual maintenance costs, the long-term annual savings can be substantial.

5.3 Advantages and disadvantages of alpacas and llamas as LGA's

Advantages:

- Longevity. The active working life of an alpaca or llama is 10–15 years.
- Minimal training requirements. Achieve guardian status in 4–6 weeks.
- Minimal special management requirements for maintenance and food.
- Can be managed similarly to sheep and goats.
- Need minimal supervision.
- Can be used with other non-lethal and lethal predator control methods

Disadvantages:

- Llamas may jump fences to join other groups of sheep or other llamas.
- If single llamas are in adjacent paddocks they may spend more time socialising with each other than protecting the livestock.
- They may occasionally injure or harass lambs.
- Intact males may injure ewes by trying to mate with them.

6. Donkeys



Guardian donkeys on a sheep property in the ACT. Photo: D Jenkins

Donkeys are docile around people but are aggressive towards canids and can be used with sheep and goats to deter predators. Donkeys are becoming more popular as livestock guards

(particularly for sheep and goats) in the United States (Walton & Field 1989; Annon 1994) and Canada (Tapscott 1997).

In Texas almost 22% of sheep and goat producers either currently use or have tried using donkeys to protect their animals from predators, mainly coyotes, but also foxes. The success rates of donkeys reducing predation have been variable but this may reflect unrealistic expectations by producers and/or inadequate/inappropriate training and management practices (Anon 1994; Walton and Murray 1989; Tapscott 1997).

Texas has the highest population of sheep and goats for any state in North America; 1.9 million sheep, 1.5 million angora goats, 400,000 Spanish goats and smaller numbers of dairy goats. Predators consist mainly of coyotes, bobcats, grey foxes, feral pigs, and golden eagles and they cause about \$9 million in annual losses to the Texan sheep and goat industry, with coyotes accounting for half these losses (Walton & Field 1989). In 1989 about 16% of Texas sheep and goat producers were using donkeys and there were also donkeys being used on about 100 farms in Virginia (Walton & Field 1989).

In Ontario, Canada, predation is threatening the viability of some livestock operations. Predation increased almost three times between 1986 and 1995. Between 1991 and 1994, farmers were compensated for predation losses averaging \$388,000/year under the Livestock, Poultry and Honeybee Protection Act. These losses are only those attributed to wild predators (predominantly coyotes) and exclude losses due to feral and domestic dogs. The use of animal livestock guards is increasing in Canada with donkeys being particularly popular (Tapscott 1997).

Currently in the western Alps of Switzerland donkeys are being used to protect sheep from wolves. Wolves have been encouraged to recolonise areas from which they had been eradicated. These wolves have migrated in from Italy and they are a problem predator to the local sheep flocks (Landry 1997). Farmers in this area of Switzerland are being re-educated in the use of livestock guarding animals to help protect their flocks. In south-western Switzerland farmers are experimenting with donkeys against wolves, marauding domestic dogs and tourist's dogs. The early results are encouraging, particularly with small flocks of less than 50 animals grazed in paddocks, but the true value of donkeys as livestock guards for sheep in Switzerland has yet to be fully evaluated (Landry 2000).

6.1 Points to consider when investing in donkeys as LGA's

- Use only a jenny or gelded jack (intact jacks are too aggressive towards livestock).
- Use only single donkeys with each flock (except in the case of a jenny and a foal).
- Allow 4–6 weeks for a naive donkey to bond with the sheep or goats and for the livestock to get used to the presence of the donkey.
- Remove donkeys during lambing.
- Select only donkeys that show strongly aggressive behaviour towards dogs by challenging new donkey recruits with a dog.
- Use donkeys in small open pastures
- Use donkeys with flocks no larger than 200–300 animals. Flocks of 100 or less if the paddock is undulating with bushes and/or rocks providing cover for predators.
- Avoid livestock feeds containing any anabolic agents (Rumensin or urea) as these are poisonous to donkeys

(Walton & Field 1989; Annon 1994; Annon 2003; Tapscott 1987)

6.2 Factors influencing the effectiveness of donkeys as LGA's

The effectiveness of donkeys in protecting livestock seems to be highly variable. This variation may reflect the relative aggressiveness of individual donkeys towards canids. Some donkeys are not aggressive towards dogs whilst others are very aggressive. Walton & Field (1989) and Tapscott (1997) identified additional reasons for donkeys failing to adequately protect livestock and these included:

- Putting a donkey in with too many head of stock.
- The stock do not 'flock' when threatened and become too spread out for the donkey to protect.
- The paddock is too large for the donkey to patrol adequately.

6.3 Advantages of using donkeys as LGAs

The relatively low purchase price for donkeys compared to other animal livestock guards and their low annual maintenance and labour costs make donkeys an attractively economic 24 hour/day means of livestock protection. To cover their costs in their first, most expensive, year in the United States a donkey would only have to save about 4 sheep from predation (Walton & Field 1989). In Canada at current lamb prices a donkey would only have to save 2–3 lambs/year to pay for itself (Tapscott 1997).

Other attractive features for choosing donkeys as livestock guards:

- eat the same food as livestock.
- do not get out through fences as dogs do.
- require minimal labour and supervision.
- can receive similar veterinary care as livestock.
- do not chase cars or attack people as some dogs may do.
- can be used with lethal wild predator control methods that cannot be safely used if livestock are being protected by dogs.
- have a relatively long working life, up to 8–15 years service, if they are well cared for. (Johnson & Carothers 1987; Walton & Field 1989; Tapscott 1997).

7. Breeds of LGA's available in Australia

LGD breeds

- Anatolian mastiffs (Karabash), Great Pyrenees and Maremmas are available in Australia. A useful point of contact with breeders is via www.dogs4sale.com.au Follow the prompts to breeds and breeders.

Alpacas

- Check local Yellow Pages under Alpacas and Llamas.
- There are a number of alpaca breeders in south eastern Australia and Tasmania, many of them are listed at http://dmoz.org/Business/Agriculture_and_Forestry/Livestock/Camelids/Alpacas/Breeders/Australia/

- The Australian Alpaca Association Inc., Unit 2/613 Whitehorse Road, Mitcham, Victoria 3132. Phone 03 9873 7700. Alpacas can be bought from here and they have compiled a Breeders Directory.
- Alpaca Breeders Directory http://www.alpaca.asn.au/breeders/list/nsw_cw.html

Llamas

- Check local Yellow Pages under Alpacas and Llamas.
- Llama breeders are less widespread than alpaca breeders. A useful starting point is with the Llama Association of Australia on www.ne.com.au/~moore/ Llamas are available through the Association. The Association also has a members directory.
- Postal address for the Australian Llama Association:
Ardcree Llama Farm
200 Hermsley Road
Curlewis,
Victoria 3222

Donkeys

- Donkeys are readily available. Check 'For Sale' sections of newspapers or agricultural newspapers for private sales and local Yellow Pages for breeders.
- Donkey societies sell donkeys and have registers of breeders.
- Donkey Society of Western Australia www.hostwa.com.au/dswa/
- Donkey Society of Victoria skypepark@peninsula.hotkey.net.au
- Mule & Donkey Society of South Australia ferals@arcom.com.au
- English and Irish Donkey Society of Australia Inc.
www.homestead.com/englishirishdonkeys/

8. Where LGA's are used in Australia

Livestock guarding animals although not widely used in Australia, are currently used mostly in sheep producing areas of Australia. Some sheep and goat producers in the ACT, NSW, South Australia, Victoria, Western Australia and Tasmania use LGAs; data from a telephone survey identified 8% and 3% of producers in the ACT and one area of NSW, respectively, are using LGAs. Currently, about 2000 alpacas are being used as livestock guards around Australia (Bob Richardson, Yass NSW (phone: 02 6227 6147; email: clearview@bigpond.com.au) personal communication, see also Alpacas, Section 7). A directory of users is not available.

9. Summarised telephone survey results and comments from producers

Producers contacted in a telephone survey were selected randomly from lists of producer telephone numbers provided by the Yass RLPB and every ninth person on the list was contacted. (In 3 cases the numbers were incorrect and the next number on the list was contacted instead.) Because there were fewer producers in the ACT, every eighth producer on the ACT list was contacted. The

president of the ACT Lessees Association and a producer using Maremmas as guards for poultry were interviewed and also included in the survey.

9.1 Data and producer comments from a telephone survey

NSW: Yass RLPB Ratepayers n = 65/646 (5 refusals, analysis on 60 completed surveys)

ACT: ACT Lessees n = 25/182 (no refusals, analysis on 25 completed surveys)

Property size (hectares)	1–500	501–1000	1001–1500	1501–2000	>2000	
ACT n= 25	19 (76%)	2 (8%)	3 (12%)	1 (4%)	0	
NSW n= 60	29 (48%)	13 (22%)	9 (15%)	1 (2%)	8 (13%)	
Livestock species on farms	No stock	Sheep	Cattle	Sheep & cattle	Goats	Other
ACT	1	2 (8%)	6 (24%)	11 (44%)	0	Horses 7 (3 agistment properties) Free range chickens 1
NSW	0	35 (58%)	0	25 (42%)	1 (2%)	Alpacas 2 (3%) Horses 1 (2%)
Sheep	Flock size					
	1–500	501–1000	1001–1500	1501–2000	>2000	
ACT n = 12 (one refusal)	5 (42%)	1 (8%)	2 (17%)	3 (25%)	0	
NSW n = 60	2 (3%)	10 (17%)	7 (12%)	7 (12%)	34 (57%)	
Cattle	Herd size					
	1–50	51–100	101–150	151–200	>200	
ACT n = 17	11 (65%)	1 (6%)	1 (6%)	2 (12%)	2 (12%)	
NSW n = 25	10 (40%)	9 (31%)	2 (7%)	2 (7%)	2 (7%)	

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Free range chickens	Flock size							
	1000							
ACT	1							
NSW	0							
Neighbours		ACT			NSW			
Private – Resident		21 (84%)			37 (62%)			
Private – Resident & absent		0			23 (38%)			
Forestry		4 (16%)			2 (3%)			
ACT/NSW park/reserve		7 (28%)			4 (7%)			
Dept Land/Water Cons		0			3 (5%)			
Council reserve		1 (4%)			2 (3%)			
Other:								
Sub divisions/hobby farms					3 (5%)			
Railway line		2 (8%)						
Urban suburbs		4 (16%)						
Golf course		1 (4%)						
Highway/road		5 (20%)						
Naval base		1 (4%)						
CSIRO		1 (4%)						
ACT education center		1 (4%)						
National Trust property		1 (4%)						
	ACT			NSW				
	Yes	No			Yes	No		
Had you heard of livestock guarding animals (LGAs) before I spoke to you?	21 (84%)	4 (16%)			54 (90%)	6 (10%)		
Do you think livestock guarding animals are effective?	3 (12%)	2 (8%)	Don't know	Told they are	22 (37%)	6 (10%)	Don't know	Told they are
			19 (76%)	17 (68%)			32 (53%)	17 (28%)
Would you	14	11	Maybe		27	28	Maybe	

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consider using LGAs?	(56%)	(44%)	0	(45%)	(47%)	5 (8%)
What type of LGAs would you choose?	7 (28%) 8 (32%) 0 3 (12%)		Don't know, need more information 7 (28%)	16 (28%) 37 (65%) 6 (10.5%) 3 (5%)		
Do you already use LGAs?	2 (8%)	23 (92%)		2 (+1*) (3%)	57 (+1*) (95%)	
If so, what species?	Mongrel domestics (1) Dogs Maremmas (1) Alpacas Alpacas (1) Llamas Donkeys			Alpaca (2) Maremma (1*)		
Would you use any other species?	Yes 1 (geese)	no 1		Both producers said No [#]		
Do you have livestock predation problems?	12 (48)	13 (52)		47 (78%)	13 (22%)	
If so, from what species?	Wild dogs/ dingoes 1 (4%) 8 (32%) Domestic dogs 11 (44%) Foxes 1 (4%) Other: Eagles 1 (4%) Crows 1 (4%) Pigs 1 (4%)			5 (8%) 7 (12%) 52 (85%) 4 (7%) 20 (33%) 0		
Estimated losses in last 12 months	Lambs 2%–28% Sheep 3%–11% Calves 7% Chickens 1%			Lambs <1%–40% Sheep 1–3.5%		
Producers requesting a	Yes	No		Yes	No	

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copy of the report and the survey results	18 (72%)	7 (28%)			47 (78%)	13 (22%)	
Producers interested in being involved in a LGA effectiveness study	9 (36%)	16 (64%)			33 (55%)	27 (45%)	

* This producer does not have LGAs — his neighbour does. This producer lambs at a different time to his neighbour. When this producer has lambs on the ground and his neighbour does not, the Maremmas take up residence in the paddock with his lambing ewes. They protect the ewes and lambs and have never caused problems.

One alpaca user was very happy with the results, zero losses since getting the alpaca. The other felt his alpacas were useless and would not consider using LGAs again.

Comments from interviewees:

ACT

Don't know, told they (LGAs) do work
 Need more info
 Think they do, will do anything to protect stock from marauding town dogs
 Rather use LGAs than toxins
 Don't know, need to see some research
 Don't know, need to look into it
 Would not use them because worried about Johnes disease transmission to sheep
 Worried about LGA aggression towards working dogs
 Would use LGAs if benefits outweigh the costs

NSW

Don't know but heard they do
 Alpacas are best because they are tall, see better than dogs
 Would like more information
 Need to know more about them (LGAs)
 Concerned about spread of foot rot to sheep from Alpacas and Llamas
 Would use LGAs if it can be demonstrated they work
 Too much extra work to use Maremmas
 Would use them if they were shown to be cost effective
 Worried about stock being attacked, hurt or killed (by LGAs)
 Would not use them (Maremmas) because there are too many roads through property
 Too much to do already, don't think benefits outweigh the extra work
 Would use LGAs if it could be shown they work
 Would not use (LGAs) until more information is available
 Would not use alpacas or llamas because of worries about contaminating the clip
 Don't know, like to try, heard good reports about Maremmas
 Don't like the idea of dogs being left alone in a paddock (animal welfare concern)
 Don't want to diversify into new things, too much extra work
 Had a Maremma once, it was aggressive with the children

Would use them if the benefits can be demonstrated
Sceptical
(LG) Dogs not suitable for large acreage
Would like to try them to see if they work
Likes the idea of constant surveillance for predators
Too expensive
Depends on cost
They (LGAs) might cause more problems
Depends on paddock size
Heard stories they are no good
Don't know

9.2 Australian livestock producers perception of LGAs

Livestock predation is a problem for 48% of ACT producers and for 78% of NSW producers interviewed in our survey. In both jurisdictions, foxes were identified as the main predator by the majority of producers (ACT 44%; NSW 85%). Eighty four percent of the 25 ACT producers and 90% of 60 NSW producers interviewed had heard of LGAs. Based on the results obtained from the survey there is a general high level of awareness and interest in the topic of LGAs and about half of those producers surveyed in both ACT and NSW said they would consider using LGAs.

The level of interest in LGDs was the same (28%) in both the ACT and NSW but Maremmas appeared to be the only LGD breed heard of by any of the interviewees. The LGA attracting most interest and the species most people would consider using in both jurisdictions was Alpacas (ACT 32%; NSW 65%). Nobody interviewed in the ACT wanted to try llamas but 10.5% of the producers interviewed in NSW wanted to try them. With donkeys, the converse was the case with a higher proportion of producers in the ACT (12%) prepared to try donkeys compared to 5% of NSW producers.

9.3 Situations available in NSW for evaluation of LGA's

Based on producer interviews conducted in the survey, 36% of the ACT producers and 55% of the NSW producers said they would consider being involved in evaluation trials of LGAs. However, the overriding feeling was that they needed to know much more about the topic of LGAs before they would finally agree to be involved. About three quarters of the producers interviewed in both jurisdictions (ACT 72%; NSW 78%) requested a copy of this report to obtain some reliable information on the subject of LGAs.

10. Conclusions

- 1) A controlled field evaluation of all species and breeds of LGA available in Australia needs to be undertaken urgently to determine the effectiveness of LGAs under Australian conditions.
- 2) A cost-benefit analysis and an analysis of the non-financial benefits should be undertaken for the use of LGAs under Australian conditions.
- 3) An informative booklet, in plain language, on training and maintenance of LGAs, and cost and non-financial benefits of incorporating LGAs into a livestock operation, under

Australian conditions, should be produced and distributed free of charge (or at a price covering production costs) to all NSW RLPB ratepayers.

- 4) Some clearly written articles explaining the advantages, disadvantages and cost and non-financial benefits of using LGAs in Australian livestock operations should be produced for the popular agricultural press.
- 5) A register of breeders of all species of LGAs and a list of competent trainers of LGDs are needed (a breeders directory has been produced by the Alpaca Association).
- 6) An accurate assessment of the financial and social impacts on producers and the livestock industry arising from wild dog and fox predation needs to be undertaken.

11. The Australian Experience - Case Studies

The case studies of producers using LGAs described below were not selected randomly but through the author being told about them by other producers or they were people known to the author.

11.1 Maremmas with sheep and goats

Mr and Mrs A run a goat and sheep operation in Wee Jasper, NSW. On different occasions in the year prior to investing in Maremmas, Mr and Mrs A lost 60 lambs to one wild dog in one afternoon and 25 stud goat kids in three days to foxes. Before buying their Maremmas the A's losses averaged 40%. In 1997 they purchased 2 male Maremma pups (\$250 each) and trained them intensively for 2 months. Once the dogs were working, the kidding average improved from around 60% to 75–80% (1998–2001). Main losses now are the result of eagles, cold and cold wet weather.

A bitch has been purchased and puppies are sold each year as an additional source of income. Each dog costs about \$450/year to maintain. The dogs are visited daily for feeding. Each Maremma is responsible for 50 to 100 acres and 250 kidding does and the A's feel one Maremma per paddock is adequate. The Maremmas tolerate being mustered with the sheep and have become used to the farm dogs, but they kill dogs they do not know. The A's have some problems with Maremmas straying into adjacent paddocks but have never had a sheep killed by a Maremma. The Maremmas sometimes can play roughly and draw blood. The Maremma bitch on heat does not seem to cause the males to leave their respective paddocks.

Having the Maremmas has made fox control using 1080 baits difficult.

The As are very happy with their Maremmas and other economic gains include less time spent on checking the stock, reduced mismothering, reduced tender wool and increased meat production as a result of reduced stress in the sheep.

The As regard the Maremmas as part of an integrated strategy against wild dogs but are the main strategy in protecting their sheep and goats from foxes.

11.2 Maremmas with sheep – case A

Mr B and Ms C run a 500 head superfine merino operation in the Brindabella Valley, NSW (near Canberra). Prior to investing in Maremmas, B and C lost about 60% of their lambs annually to wild dogs and foxes, in addition to the adult sheep lost to wild dog predation. In 1997 a Maremma was purchased for \$750. In the first year following the purchase, the lambing average improved to 110%. The dog paid for itself in one season. Mr B and Ms C now have 11 livestock guarding dogs

consisting of Maremmas and Great Pyrenees and sell some puppies each year. Occasionally dogs are lost to snake bite.

Mr B and Ms C regard the livestock guarding dogs as important adjuncts to conventional wild dog and fox control (mainly trapping with some baiting) undertaken locally. Mr B and Ms C are certain that without the livestock guarding dogs they could not run sheep on their farm and make a living.

11.3 Maremmas with sheep – case B

The sheep property of Mr D abuts Crown Land at Ebor, north eastern NSW. In the year prior to buying his first Maremmas, Mr D lost 600 sheep (wethers) in 3 weeks to wild dogs. Four desexed, pre-trained male Maremmas were purchased from a Maremma breeder/trainer in Shepparton, Victoria. The dogs bonded with the sheep in 3–4 days. Mr D now has 11 Maremmas and sheep losses since the investment in the Maremmas have dropped by about 98%. Three Maremmas are routinely run with 1500 wethers in 200 hectares. The dogs are hopper-fed with dry dog food and the hoppers are filled weekly. Three to four bags of dry food are consumed by the dogs each week. The Maremmas tolerate the farm dogs mustering the sheep. After shearing, Mr D's manager reported it takes the Maremmas as long as a month to get used to the shorn sheep. Without the Maremmas, Mr D's manager is convinced it would be impossible to run a viable sheep operation on the property.

11.4 Maremmas with poultry

Ms E is a free range egg (chicken) producer using Maremmas to protect the poultry. The current owner Ms E took over the property with several hundred chickens and one Maremma in residence. Anecdotal reports by the previous owner described regular attacks by foxes with losses of as many as 100 birds killed in a single incident before investing in the Maremma. Following a fox attack egg out-put would drop dramatically for about one week. Ms E purchased more chickens, finally running more than 1000 head. She also acquired 3 more Maremmas. Chicken losses were never more than 2–3/month, rarely to foxes, sometimes to eagles. Over a 2–3 year period the owner reported finding 3 dead foxes in the chicken paddocks, allegedly killed by the Maremmas. Ms E diversified into ducks and purchased some geese to use as guards. The ducks and geese were separated from the Maremmas by dog proof fencing. The geese were ineffective in protecting the ducks against foxes, foxes attacked the ducks regularly and a number of ducks were killed over several weeks. Ms E opened a gate allowing the Maremmas access to the paddock containing the ducks and geese, the Maremmas took over this new territory and duck deaths to fox attacks ceased. Ms E found the Maremmas to be highly effective in protecting her poultry from fox attacks and the dogs had a calming effect on the chickens.

11.5 Llamas with poultry

Ms F runs an alpaca and llama farm at Sutton, NSW. Within the first few weeks of moving to the property, foxes decimated her free range population of chickens. Following the arrival of her llamas she never lost another chicken.

Ms F now runs about 100 llamas and between 200–300 alpacas, for their fibre. Before the arrival of the llamas and the alpacas foxes were numerous everywhere on their farm, now they never see a fox on the property except occasionally a well-trodden carcass is found in a paddock.

Llamas cost \$1000–\$2500 each and live for 20–30 years. Ms F recounted several stories of llamas she has sold as livestock guards, effectively protecting flocks of lambing ewes and kidding goats.

Ms E sells 10–15 alpacas and 5–10 llamas annually to customers wanting to use them as livestock guards.

11.6 Alpacas with sheep – case A

Mr F runs a 30,000 head sheep operation at Skipton (near Ballarat, Victoria). His main problem is predation on lambs by foxes. Mr F began using alpacas with his lambing ewes in 1999. He obtained some alpaca wethers and ran 6 alpacas per 1000 merino ewes as a trial. He compared results with a flock of 1000 ewes on similar grazing and type of country that did not have alpacas guarding them with the flock that included the 6 guard alpacas. At the end of the first year of the trial, Mr F had 14% more lambs reared successfully from his ewes guarded by the alpacas. Mr F obtained more alpacas and now has 20. The results from years 2000 and 2001 were not as impressive as 1999, but the flocks with guard alpacas consistently successfully rear, conservatively, between 5–10% more lambs than similar flocks on his farm that are not guarded.

Mr F is very pleased with the results and is intending to continue using alpacas. He is using them because they require minimal maintenance, no special feeding or training and they can be treated similarly to sheep. Mr F said he felt he could not manage enough Maremmas to protect all lambing ewes.

11.7 Alpacas with sheep – case B

Mr G has a property that abuts the southern suburbs of Canberra. He introduced alpacas into his sheep operation in 2000. He wished to protect his sheep, particularly lambing ewes from foxes and marauding town dogs. Four alpacas costing \$250 each were purchased and two alpacas were run with each of two flocks of 300 ewes. One flock is in a comparatively open paddock, the other on a hilly paddock with several stands of trees and two rough rocky outcrops. When visited by the author, the sheep and alpacas were running together in the flatter open paddock but in the rougher paddock, the sheep had split into 3 groups and the alpacas had remained with the largest group of sheep. The alpacas in the rough paddock did not have ‘line of sight’ to the other two smaller groups of sheep or one ewe on her own that had just given birth to a lamb. The sheep out of sight of the alpacas were completely unprotected from predators.

Mr G does not have data on the effectiveness of the alpacas but thought they had been effective in reducing losses.

11.8 Donkeys with sheep

Mr H introduced donkeys for added protection of his sheep against foxes in 2001. Wild dog trapping goes on in Crown Land not far from his property but he rarely has a wild dog problem. Foxes are the main source of predation on his lambs. Fox control is undertaken periodically on and around his property but he has invested in donkeys as some ‘added insurance’. Average annual predation losses are 15 sheep, but this is mostly lambs. In 2001 Mr H bought 2 donkeys (a gelded male and an entire female). The gelding proved not aggressive towards dogs so this animal was exchanged for a different gelding that had ‘real attitude towards dogs’. Mr H plans to run donkeys in a 8.5 hectare fenced paddock with 300 ewes.

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Appendix 1

An outline for a preliminary study to evaluate the relative effectiveness of LGAs

In view of the major interest by farmers in alpacas for guarding livestock, highlighted in the telephone survey, it would be a practical to first evaluate the various species of non-canids used for guarding livestock.

Study time

Four and a half years with a 6 months set-up period.

Study design

Tasks to be undertaken during the set-up period.

- Identify 21 farmers, on similar farms (9 with fox predation problems and 9 with wild dog/fox predation problems, 3 others with either problem), willing to participate in the

study. Eighteen farms to have LGAs installed (i.e. 6 alpacas; 6 llamas; 6 donkeys) and 3 farms also with predation problems to remain as nil treatment controls.

- Purchase/procure the LGAs.
- Assess the aggressiveness of the guards against canids.
- Determine which species will be placed on each farm.
- Allow 4 weeks for the LGAs to acclimatize to their new surroundings and get to know their flock.
- Establish data recording system.
- Determine a compensation amount with the farmer for livestock that may be lost to predation during the study only in the study paddocks.
- Identify a veterinarian to be used in the case of a livestock guarding animal being injured.
- Obtain AEEC approval for the project.

Project design

The 18 treatment farms with predation problems will be divided into 2 groups of nine, 9 farms with only fox predation and 9 farms with wild dog/fox predation in the other group.

Three farms with fox-only problems will be supplied with one alpaca, three with a llama and three with a donkey each. Similarly the farms with wild dog/fox problems will be supplied with alpacas, llamas and donkeys. One alpaca, or one donkey or one llama will attend a separate mob of 50–100 lambing ewes in separate paddocks (not adjacent to each other).

On the other three farms no LGAs will be installed, but a mob of lambing ewes on each property will be divided off and maintained similarly as on the farms with the LGAs.

All the ewes will be ultrasound scanned to confirm pregnancy rates. At lambing time, on all farms, as far as possible, all still-born lambs will be removed counted and recorded. Regular checks of the sheep/lambs (daily if possible, otherwise, minimum weekly) will be undertaken to monitor predation. All dead/maimed animals will be recorded, including any animals euthanased because of injuries received.

This regime will be maintained for 2 years. All data on losses and costs associated with the maintenance of the guard animals collected and recorded.

At the end of year 2 all LGAs will be removed from the farms, new LGAs reallocated to the farms such that no farm has the same treatment as it had for the previous 2 years. Of the farms with both dogs and foxes, three that were previously allocated an alpaca, a llama and a donkey become nil treatment controls.

This situation will be maintained and monitored, similarly to the previous 2 years, for a further 2 years.

After 4 years the results/losses for all the farms with and without LGAs will be compared and evaluated. The results will be published in the scientific literature, in the popular agricultural press, and a leaflet on training, use, effectiveness, economics and sources of LGAs prepared for distribution to producers through RLPBs with rate notices.



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